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Unicompartmental knee arthroplasty suitability: a retrospective study at Chris Hani Baragwanath Academic Hospital

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UNICOMPARTMENTAL KNEE ARTHROPLASTY SUITABILITY

A Retrospective study

at

Chris Hani Baragwanath Academic Hospital



Dr Edmund Nkhensani Thwala

A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of

Master of Medicine

Johannesburg, 2020

Declaration

I, Edmund Nkhensani Thwala declare that this Research Report is my own, unaided work. It is being submitted for the Degree of Master of Medicine in the branch of Orthopaedic Surgery at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.



Dedication

To my wife Dipuo Thwala

I cannot thank you enough for the patience you have had while I followed my passion.

To my mother, Agnes Shalate Thwala,

As you always told me “hard work pays”, thank you!

Presentations arising from research project

This study was presented at the 28th South African Orthopaedics Association annual congress 2018 September.

Abstract

Background: Having noticed the limited practice of unicompartmental knee arthroplasty (UKA) at Chris Hani Baragwanath Academic Hospital (CHBAH), the urge to understand principles involved in the surgery and practice in general, arose. With review of literature, we understood the course that the practice of UKA had taken in the past two decades, where in the early nineties it was popular, but due to high revision rates, it saw a decline. Revivers of UKA then established the need to give attention to patient selection and established criteria deemed essential to prevent the high failure rates. Even then only 6% of patients are expected to be suitable for UKA. The large number of patients seen at CHBAH was the basis of our interest to establish if our patients met the criteria for UKA. This would also give an insight into the pattern of knee affectation by Osteoarthritis in our local population.

Methods: Following acquisition of both the University of the Witwatersrand Human Research Ethics (HREC-Medical) and CHBAH Institutional Ethics approval for our study, we conducted a retrospective review of patient records for a period of three years, i.e. 2015 to 2017. A data collection sheet was used to collect the data highlighting the essential criteria for UKA in each patient and also sampling information on the pattern of Osteoarthritis at CHBAH.

Results: Following the application of exclusion criteria, a total of 202 patients were left for evaluation of suitability for UKA and to assess the pattern of manifestation of Osteoarthritis (OA) of the knee at CHBAH. The bio-demographic distribution of the study population showed a 1:1.3 male to female ratio with the total number of patients being 2.7 times more than the recommended number to meet the power analysis as calculated in the Methodology section. The overall findings showed advanced stages of tricompartmental and bicompartmental OA, with women showing a more advanced disease, even in the few cases of unicompartmental OA. None of our patients met criteria for UKA when the traditional criteria were used.

Conclusion: The practice of UKA remains a popular topic with high levels of scrutiny. Our study found that all our patients were not suitable for UKA after the application of the traditional criteria. Furthermore, the unsuitability for UKA was predominantly due to high body mass index (BMI), advanced age and severe forms of OA. With improvements of biomaterials and surgical techniques, higher levels of BMI and advanced age are now acceptable for UKA with new criteria dedicated to the use of these new implants. We remain confident that more patients will be suitable for UKA with the new criteria.

Acknowledgements:

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- Prof C Frey
- Dr M Jingo
- Dr R Greeff
- Dr J Wessels

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Abbreviations

ACL	Anterior Cruciate Ligament
AP	Anterior Posterior
BMI	Body Mass Index
CEO	Chief Executive Officer
CI	Confidence Interval
CHBAH	Chris Hani Baragwanath Academic Hospital
FFD	Fixed Flexion Deformity
HREC	Wits Human Research Ethics Committee
ROM	Range of Motion
SD	Standard Deviation
SONK	Spontaneous osteonecrosis of the knee
TKA	Total Knee Arthroplasty
UKA	Unicompartmental Knee Arthroplasty
WHO	World Health Organisation

CHAPTER 1

1 Introduction and literature review

1.1 Arthroplasty background

Arthroplasty, which in simple terms means joint reconstruction, is a well-established field of orthopaedics that continues to grow vastly due to an enormous amount of contribution from research. Scientific research on knee arthroplasty dates as far back as the early 1900s (1). This has added to the evolution of medicine where a diseased part of the body can be resected out and its function be carried by a man-made replacement. In the case of the knee this would be the "prosthesis" used in knee arthroplasty.

In anatomical terms, the knee joint is classified as a complex hinge type of joint (2). A hinge joint allows movement only in one plane. In the case of the knee, the movements are primarily flexion and extension, with kinematic analysis showing that there is also gliding and rolling of the articular surfaces (2). The bones making up the knee are the two distal femoral condyles, the patella and the proximal tibia. The anatomy is such that it is composed of three compartments, namely (i) the patellofemoral joint: which is the articulation between the distal femur and the patella, (ii) the medial and (ii) lateral knee joint compartments: made of the two femoral and the two tibial condyles (2) (see Figure 1.1). The ultimate functions of the knee joint are to transmit weight through each lower limb and allow locomotion (3).

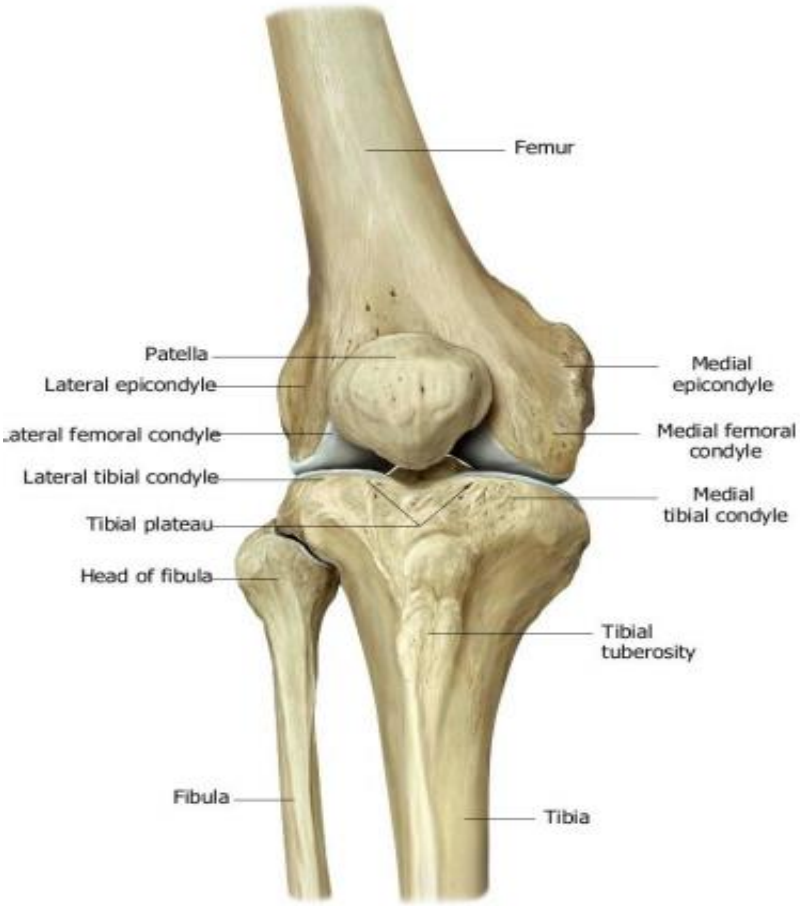


Figure 1.1: Picture illustrating parts of the knee joint (4)

Knee arthroplasty surgery is performed commonly for Osteoarthritis (OA) of the knee (5). This disease process can be as result of age-related degenerative wear, where no obvious cause is known. In this instance it is referred to as "primary Osteoarthritis" (5). It may also occur as a complication following trauma, when there is a fracture of one of the bones of the knee. Additionally, it may follow infections, an example being Tuberculosis, and also following Spontaneous Osteonecrosis of the knee (SONK) and an autoimmune inflammatory disorder such as Rheumatoid arthritis. In this instance, it is referred to as "secondary Osteoarthritis" (5). The severity of the condition can be variable, presenting with mild to severe pain and disability that limits basic daily living activities (3).

More often, the progression of Osteoarthritis of the knee starts in a single compartment before spreading to other unaffected compartments (5). A classic example is that of a fracture through the lateral tibial condyle, where years following healing, radiographic changes suggestive of Osteoarthritis are noticed only in the previously affected compartment. In time, if there is no treatment, the disease process will then spread to affect the remaining compartments. Understanding of the progression of disease through the knee compartments has resulted in the evolution of two types of knee arthroplasties (5). These are namely; Unicompartmental Knee Arthroplasty (UKA) and Total Knee Arthroplasty (TKA).

The role of knee arthroplasty in Osteoarthritis, either primary or secondary, is multifaceted. The primary aim of the surgical intervention is to alleviate pain so that basic activities of daily living can be restored (5). With improvement in prosthetic design, biomaterials and surgical techniques, secondary gains from arthroplasty surgery now include enabling patients to undertake recreational and leisure activities (1). Moreover, with these improvements, the decision to utilise a specific type of knee arthroplasty implant should be tailored to the specific needs of the patients (5).

1.2 Total knee arthroplasty (TKA)

In TKA, the entire articular surface of the tibia, the femur and the patella are replaced with prosthesis (3). This is also called tricompartmental knee arthroplasty as all three compartments of the knee are replaced by prosthesis (5) (see Figure 1.2). This way, body weight is transmitted through the prosthesis covering the ends of the bones. The nomenclature, TKA, is also used in instances where only the tibial and femoral articular surfaces are replaced with prosthesis, leaving out the patella articular surface, as this is now becoming a rare practice (1). In this case, the name bicompartmental knee arthroplasty is appropriate; although TKA is still used interchangeably (5) (see Figure 1.3).

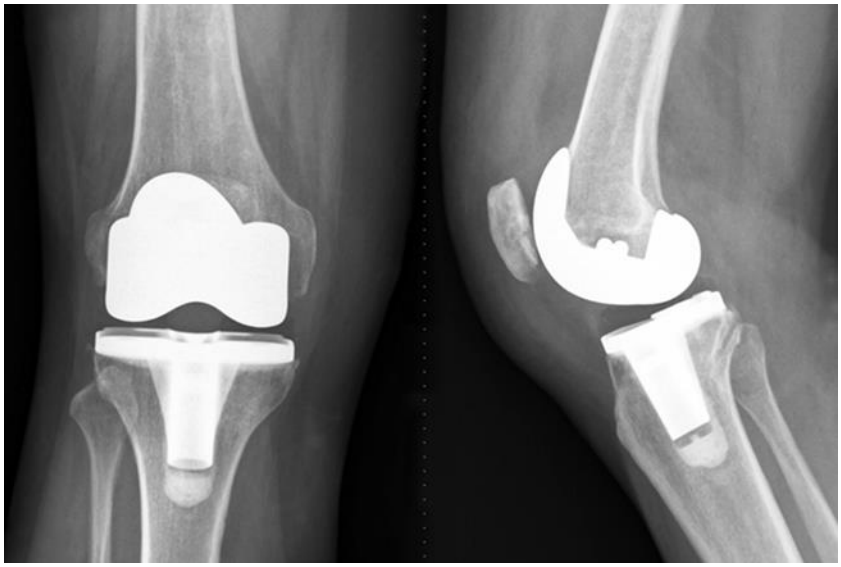


Figure 1.2: Illustration of TKA where all articular surfaces are replaced by prosthesis, including the patella, also referred to as tricompartmental knee arthroplasty (6)



Figure 1.3: Illustration of TKA where only the tibial and the femoral articular surfaces are replaced by prosthesis also referred to as bicompartmental knee arthroplasty (7)

The primary indication for TKA is disabling knee pain from Osteoarthritis that cannot be alleviated by non-operative intervention, among other conditions (5). These include high dosages of variable analgesia, physical activity modification and weight loss (5). Another indication for TKA is disability following deformity that limits normal day to day functions such as difficulty getting out of bed, sitting on a toilet seat or chair that requires bending of the knee and difficulty using public transport (5).

TKA has demonstrated survivorship of more than 15 years in over 95% of patients (8). This is reported in many arthroplasty registries world-wide (8). The fact that implanted prosthesis are expected to last a predictable duration makes TKA the preferred approach in older patients (1). This way, the life expectancy of the implants is expected to be longer resulting in reduced need for revision surgery (5). Furthermore, the surgical skill of TKA is practiced so often, as it is a common surgical technique that has become much easier to be performed by most arthroplasty surgeons (1).

1.3 Unicompartmental knee arthroplasty (UKA)

In UKA, only the compartment affected by Osteoarthritis is “replaced” (5). This could be the medial or the lateral compartment. Isolated replacement of the patellofemoral compartment, although not commonly performed, is also referred to as unicompartmental knee arthroplasty (5) (see Figure 1.4).

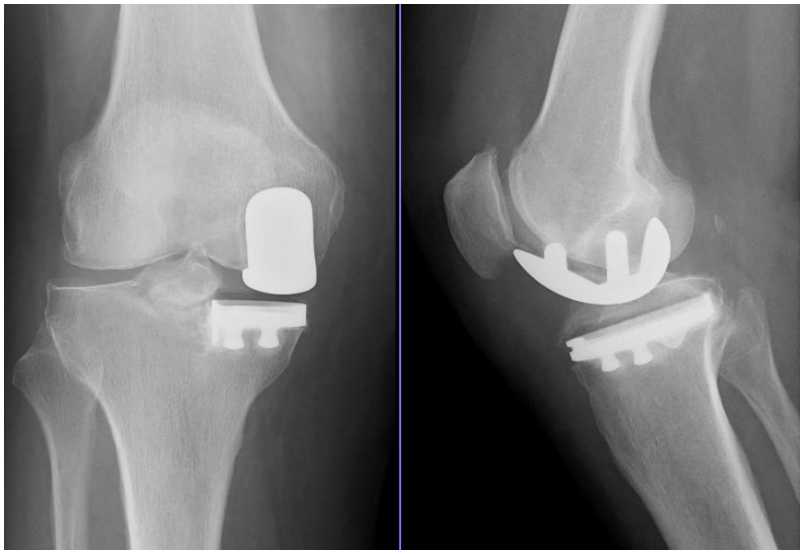


Figure 1.4: Illustration of UKA (9)

Until the late 1990s, UKA was a common practice in knee diseases that were confirmed to be unicompartmental (1, 10). Only then, were a number of studies, with enquiry into the high number of cases requiring revision surgery, published. These studies were emphasising on factors leading to an increase in high failure rates that were seen in UKA. The modes of failure were either by implant loosing or progression of disease to previously unaffected knee compartments (10). A strong emphasis was placed on proper patient selection for UKA in order to reduce failure. This debate had marked one of the pivotal questions in knee arthroplasty being who, when and where to use either UKA or TKA (1)?

In a paper published in the Journal of Bone and Joint Surgery in 1989, Kozin et al. stipulated the currently and popularly accepted selection criteria for patients suitable for UKA (11). Evaluation of these criteria is done with both clinical examinations of patients and review of X-rays of the affected knee. They recommended use of UKA in patients with:

- unicompartmental Osteoarthritis or Osteonecrosis (which could be medial or lateral),
- age older than 60 years,
- low demanding physical activity,
- weight less than 80 kg (body mass index (BMI) of less than 30 kg/m^2),

- minimal pain at rest,
- range of motion (ROM) arc of 90 degrees or more,
- less than 10 degrees of medial angular deformity (varus deformity), and 5 degrees lateral angular deformity (valgus deformity), these are deformities in the coronal plane
- less than 5 degrees of fixed flexion deformity (FFD) (deformity in sagittal plane)
- intact knee ligaments

Close examination of these criteria show that they allow for prolonged implant survival (1, 3). The criteria are curtailed such that low demand is placed on the implant and allow UKA in only mild to moderate severity cases of knee disease. In cases where these criteria are not met, TKA would need to be performed (12).

Further work was done by Oosthuizen et al. on UKA to emphasise these generally accepted parameters (10). Here, the researchers utilised the radiological evaluation of the affected knee to determine either if the disease is unicompartmental or if it affects more than one compartment. They also assessed the stability of the affected knee and devised a formula, which they demonstrated to be reliable in selecting suitable candidates for UKA (10). Use of formulae and simplified guidelines have proven to be useful in the field of medicine, as these make the thought processes in decision making simple. This also applies in the decision to treat patients with UKA where patient selection should be cautious (1).

Over the years, improvements in prosthetic biomaterial, implant design and surgical technique have resulted in scrutiny on the validity of some of the factors acknowledged to cause accelerated prosthetic wear in UKA (13). The factors in question are obesity, age below 60 years and moderately high levels of physical activity. In their 2005 paper, Tobar et al. demonstrated the long term survival of UKA in patients with a BMI above 30 kg/m^2 and middle aged individuals (45 – 50 years) (14). The evolution of biomaterials and use of

improved implants is so rapid that survival of prosthetic implants used in arthroplasty is constantly improving (8, 13).

1.4 UKA *versus* TKA

As diseases of the knee requiring treatment with arthroplasty progress, there are different schools of thought with respect to the type of treatment that can be offered (3). On the one extreme is an understanding of the knee as a single compartment. Here emphasis is made on the fact that the disease manifesting in any compartment of the knee will later spread to unaffected parts (15). This school of thought offers intervention in the form of TKA, where all the compartments are replaced. On the other hand, is the school with the thought that attention should be focused only on the affected compartment, where appropriate. Here a UKA is performed to address only the affected part (1). TKA would only be used as a salvage procedure following failure of the UKA or further spread of the disease to other compartments.

The unicompartmental nature of the disease requiring arthroplasty is the cornerstone requirement in deciding on UKA (1). Osteoarthritis and Osteonecrosis are two of the few common conditions where the disease manifests either in the medial or lateral compartment before spreading throughout the knee (16). On the other hand, conditions such as autoimmune inflammatory arthritis and infective conditions, where the disease affects all the compartments of the knee from an early onset, are absolute contraindications for UKA (11, 15). A common example of an autoimmune inflammatory condition is Rheumatoid arthritis, which affects a significant number of patients seen in many arthroplasty units (5). Other undebatable contraindications to UKA include severe pain at rest and patients with high physical activity levels (15). The severity of pain can be extrapolated to signify advanced disease despite radiological evidence, where changes may appear mild. Consideration of high level of physical activity as a contraindication is proposed solely to avoid accelerated wear of the prosthesis due to the high demand by the highly active patient. TKA is the recommended intervention in these instances (17).

Performance of UKA, where appropriate, has incomparable benefits when compared to TKA. These are:

- shorter hospital stay. Lombardie et al. reported a post-operative stay of 1.4 days for UKA *versus* 2.2 days for TKA (18).

- range of motion at 6 weeks is better for UKA than for TKA, although it levels in both treatments at 8 weeks (17, 18). This implies quicker rehabilitation.

- in experienced hands, the performance of UKA takes a shorter time (11). As anaesthesia is not without risk, especially in elderly patients, the benefit of shortened anaesthetic time is very crucial.

An important tool for evaluating clinical outcome following arthroplasty is one that is patient based. Patient satisfaction can be assessed confidently in this manner. Pain, deformity and loss in the ability to carry out daily living activities are primary complaints in patients presenting for knee arthroplasty. These parameters are included in most pre-operative and post-operative patient evaluation tools (19). UKA has been shown to improve patient symptoms and life, when performed for the same pre-operative clinical scoring as TKA, when appropriate patient selection criteria are met (17, 19).

Revision surgery following UKA is reported to be mainly for progression of disease to unaffected compartments (15). This is followed by implant loosening, accelerated wear and knee instability (17). The longest term of survival of UKA has been shown to be well over 15 years despite the increase in the rate of revision surgery (1). As failure is a reality, Luneburg et al. demonstrated that revision surgery for UKA is not as technically demanding when compared to revision surgery for TKA (17). The authors reported less operation time, less blood loss and better functional outcome with regard to pain, range of motion and restoration of daily activities of living (17). This implies that in circumstances where UKA is performed, following the 10 to 15 years of implant survival, revision to TKA would yield better outcomes, compared to when TKA was performed as the initial surgery.

The burden of disease due to Osteoarthritis of the knees is escalating and some patients need surgery for both knees. These are often obese patients with comorbidities that pose significant peri-operative and post-operative complications from anaesthesia and the surgery itself (8). Arthroplasty of the knee is known to be complicated, commonly by deep vein thrombosis and pulmonary embolism (20). These are life threatening conditions that affect quality of life significantly. In carefully selected patients, Berend et al. reported that there is no significant difference in morbidity and mortality after two knees are operated simultaneously or at different stages when UKA is performed (20). Although surgical complication to one patient is an all or none occurrence for the individual, the performance of single stage surgery for both knees reduces the repeated anaesthetic risk exposure and ultimately the financial costs (20).

UKA is said to be preserving of patient's bone stock and native knee biomechanics (12). On the other hand, TKA has an added advantage of weight transfer through a uniform and same-biomaterial prosthesis, unlike UKA where there is half native knee and half implant (3). This consequently avoids stress concentration in TKA, hence, better survival of implants in TKA (5). In addition, this implies that the indications for UKA should never be stretched to be performed where TKA should be the primary surgery.

Radiological studies are used for evaluation of the nature and extent of damage of the compartments of the knee in arthropathies. This is essential in determining to do either UKA or TKA. Here, focus is given to changes known to be associated with Osteoarthritis (21). These include:

- narrowing of the joint space (due to cartilage loss),
- Osteophytes (bony spur outgrowths) and,
- Subchondral cysts and sclerosis adjacent to the joint.

Joint space narrowing is considered when the joint space is less than 5 mm on all the views of X-rays (21).

Different systems exist for grading the severity of affectation in knee diseases. In the case of Osteoarthritis of the knee, a grading system that has showed to be reliable with narrow variability when used by different observers for similar patients is the Kellgren and Lawrence classification for knee OA (22). This is an X-ray based classification system where the severity of affectation is graded from 1 to 4, with "1" being very minimal affectation and "4" being the most severe. In evaluation of knees for UKA, the surgeon normally prefers UKA for lower grades of OA, i.e. Kellgren and Lawrence grades 1 and 2. This is because with advanced disease, there is likelihood of bicompartmental affectation although this may not be obvious on radiological examination (23).

Until this past decade, the early millennium, there was a steady decline in practicing of UKA and the decline was caused by the emergence of literature showing high revision rates due to failure (8, 10). Through the work of persisting experts in UKA, the indications and techniques of UKA have been revised and the practice is on the upsurge again (1, 10). Patient selection is the mainstay for success of UKA and studies are emerging that report good survivorship of up to 15 years (14). Furthermore, post-operative function after revision surgery for UKA is being shown to match that for primary TKA (11). Additionally, in the public sector where there is high demand due to large numbers of patients awaiting surgery, UKA intervention seems to be more appealing as a result of reduced costs and other benefits mentioned earlier (20).

The South African health system, similarly to most developing countries, is under overwhelming pressure. This is with regards to limited financial resources and increasing numbers of patients requiring medical treatment (24). The implication of this challenge to arthroplasty units across the country is adverse (24). With regards to knee arthroplasty, the availability of the option to address only the affected compartment may seem appealing, as the cost is shown to be cheaper than that for TKA (20). Furthermore, decreased hospital stay, early post-operative recovery, reduced peri-operative morbidity and short anaesthetic time have good financial implications for a developing country, such as South Africa (24).

Chris Hani Baragwanath Academic Hospital (CHBAH) is the third largest hospital in the world and the largest in the Southern Hemisphere, serving a population of 3.5 million people. The burden of disease in arthroplasty units throughout all developing countries, including South Africa, is similar (24). The aim of the proposed study was to retrospectively look at cases treated at CHBAH over the period of 2015 to 2017 in order to determine if UKA could have been performed in some of the patients or not. We investigated if patients treated with TKA met or failed to meet the traditionally accepted criteria for UKA.

In addition, our study would allow us to identify suitable cases that could have benefited from the reduced complication rates, cost savings and other benefits such as faster rehabilitation following UKA, where suitable. Lastly, our study would also determine the prevalence of knee OA at CHBAH.

1.5 Study Aim and Objectives

1.5.1 Aim

To determine the suitability of UKA, with regard to traditionally accepted criteria, in patients treated at the CHBAH arthroplasty unit for knee Osteoarthritis.

1.5.2 Objectives

The objectives of the study were:

- to determine the prevalence of knee arthroplasty at CHBAH arthroplasty unit
- to determine the pattern of manifestation of Osteoarthritis of the knee in patients treated in the unit and,
- to determine the prevalence of patients treated for knee Osteoarthritis with TKA who met the criteria for UKA, and could have been treated with UKA

CHAPTER 2

2 Methodology

2.1 Research Question

Did patients who were treated for knee Osteoarthritis (OA) with TKA meet the suitability criteria for alternative treatment with UKA?

2.2 Hypothesis

In patients treated with TKA at CHBAH arthroplasty unit, some met the criteria to be treated alternatively with UKA.

2.3 Research Design

A retrospective review of patients' records treated for OA of the knees between 2015 and 2017.

2.4 Materials and Methods

Following acquisition of Wits Human Research Ethics Committee (HREC) (Medical) ethics and CHBAH Institutional approval, weekly morbidity and mortality presentations from the CHBAH Arthroplasty unit together with files and X-rays of patients treated for OA knee, were retrieved. These records were for all patients treated for primary and secondary OA with TKA between 2015 January and 2017 December. A data collection sheet (see appendix A) had been developed. The variables on the data collection sheet were used to identify factors

suitable to determine whether to treat patients with TKA or UKA. The data were completed using the patients' records (i.e. files and X-rays) and weekly Arthroplasty morbidity and mortality presentations. As standard protocol at CHBAH Arthroplasty unit, X-rays of knees were taken with patients supine and the patella in the centre for anterior posterior (AP) views, unless a special request is made. A supine AP and lateral X-ray of the knees was obtained in this instance. Furthermore, the data collection sheet was used to (i) determine the pattern of manifestation of OA of the knee and (ii) determine if UKA would have been suitable or not.

2.5 Sample size and selection

The patient sample was made up of all patients treated at CHBAH with TKA for knee OA between the period January 2015 and December 2017. A power analysis of 75 patients was calculated for significant statistical analysis and conclusion of the study following consultation with a statistician. Following the application of inclusion and exclusion criteria (see below), a total of 202 patients was available for evaluation.

Inclusion criteria were:

- Patients aged 18 years and older
- Patients treated for knee Osteoarthritis and spontaneous Osteonecrosis of the knee with TKA

Exclusion criteria were:

- Patients treated for knee Osteoarthritis by modalities other than arthroplasty in the form of knee replacement
- Patients undergoing revision arthroplasty
- Patients with inflammatory arthropathies
- Patients treated elsewhere with knee arthroplasty and only require rehabilitation and review at CHBAH arthroplasty unit
- Congenital causes of Osteoarthritis as indications for arthroplasty
- Cases with incomplete clinical data on both the morbidity and mortality presentation
- Cases with inadequate clinical X-rays for evaluation

2.6 Data Collection

Data were collected by the principal investigator (Dr Thwala). From weekly morbidity and mortality presentation, the data were in the form of Microsoft ® Office PowerPoint. These were collected using the principal investigator's personal computer and where information was incomplete from the morbidity and mortality presentations, patients' files and X-rays were retrieved from the hospital storage area in order to complete the missing information.

Microsoft® Office Excel was used to create a summarised database for the study data. In order to preserve patient confidentiality, unique study numbers were allocated to the individual patients. On both the data collection sheet and the Microsoft® Office Excel, no information was captured that could violate the anonymity of patients. Furthermore, the data are only available to the principal investigator and the study supervisors only. Knees found to be suitable for UKA, both on clinical and radiological evaluation, were further re-evaluated by an Arthroplasty trained orthopaedic surgeon.

2.7 Data Analysis

Assistance of a biostatistician was employed in analysis of the data. Here, a univariate analysis was done using the Student *t*-test to compare categorical data. A p-value < 0.05 was accepted as statistically significant. Basic statistics were used in the determination of central tendency and measures of spread with respect to age, BMI and measurable clinical parameters such as knee range of motion. Collected data were securely stored in the principal investigator's computer using both Microsoft® Office Word and Excel programmes.

2.8 Limitations

The main identifiable weakness of our study is its retrospective nature. Below are some of the limiting factors:

1) As some of the data were X-ray based, an anticipated short fall was the inconsistent orientation of patients' X-rays and inadequate views for complete radiological evaluation. This was an important component of our study as radiological findings are essential in determining whether knee OA involvement is unicompartmental or not, hence, bearing implication on the treatment offered. This, then resulted in exclusion of those cases.

2) Another limitation was incomplete clinical information on both the weekly Arthroplasty morbidity and mortality presentations and the patients' files. This was an error on the initial evaluation of patients at the time of the initial surgery, therefore, such cases were excluded.

CHAPTER 3

3 Results

Between January 2015 and December 2017, 480 knee arthroplasty surgeries were performed at the CHBAH arthroplasty unit. These all had TKA of which 433 cases were primary and 47 were revision surgeries. The 433 primary knee surgeries consisted of 427 patients as 6 patients had both knees operated within the study period. None of the 6 patients had simultaneous bilateral TKA, but were staged.

Of the 480 cases, 278 cases were excluded from the study. The exclusion reasons were due to 32 cases not having sufficient data for evaluation and 246 cases having diagnoses that are absolute contraindications for UKA. The breakdown of cases with absolute contraindication to UKA was made up of (i) 179 cases diagnosed with autoimmune inflammatory arthropathies, (ii) 4 cases with Polio-associated knee arthritis, (iii) 16 cases with arthritis following tuberculosis of the knees and (iv) 47 cases were revision knee surgeries.

The number left for analysis in the study was 202. Of these 114 cases were diagnosed with idiopathic Osteoarthritis of the knee, where there was no known cause for the OA, including primary OA, and 88 cases with an established diagnosis. The 88 cases were made up of 32 cases with advanced stages of spontaneous Osteonecrosis of the knee and 56 cases had post traumatic OA. Table 3.1 shows a summary of the cases included and those excluded from the study.

Table 3.1: TKA cases encountered with the cases included and excluded from the study where *n* represents the number of cases. OA: Osteoarthritis, SONK: spontaneous osteonecrosis of the knee

Description	*N*
Total cases 2015 – 2017	**480**
Cases excluded :	**278**
Inflammatory arthritis	179
Post-Poliomyelitis	4
Post TB arthritis	16
Revision surgeries	47
Insufficient data	32
Cases included:	**202**
Idiopathic OA (no known cause, including Primary OA knee)	114
SONK	32
Post traumatic OA	56

3.1 Demographic data

The study consisted of 202 cases that were evaluated for suitability of UKA. The cases were made up of 86 male patients and 116 female patients, making up a male to female ratio of 1:1.3. Figure 3.1 is a pie chart with expression of percentages of the different genders.

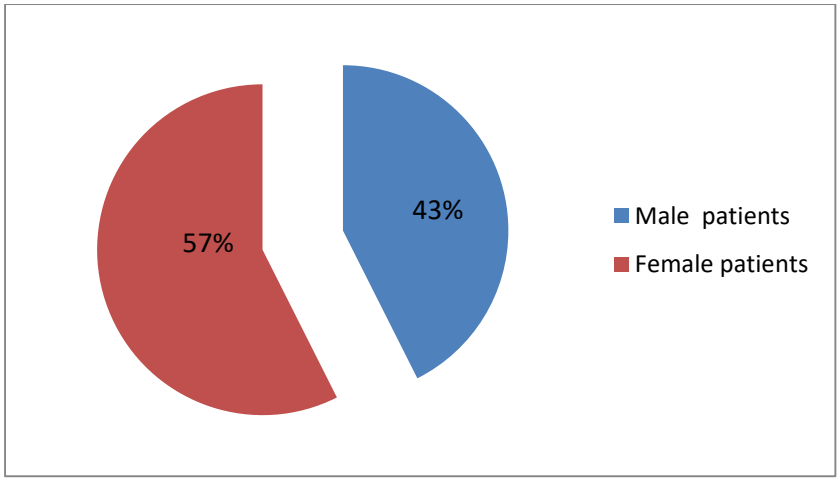


Figure 3.1: Pie chart showing percentage distribution of male and female patients included in the study

3.2 General age distribution

In the 202 patients, the ages of patients ranged from 43 to 86 years. The mean age was 67 years with a 95% confidence interval (CI) of 66.6 to 68.6. As age is among the traditional criteria for UKA, Table 3.2 shows the grouping of patients into three age groups namely, number of patients with an age less than 60 years, age 60 to 80 years and age more than 80 years.

Table 3.2: Grouping of patients according to age; *n* is the number of patients within the age category, the percentage of total is included in brackets

Age	< 60 years	60 – 80 years	> 80 years
n (%)	43 (23%)	145 (72%)	11 (5%)

3.3 Age distribution of male patients

Male patients included in the study for evaluation for suitability of UKA were 86. Their ages ranged from 57 to 86 years old. The mean age in this gender population was 72 years, with a standard deviation (SD) of 7.6. Table 3.3 shows grouping of male patients into three age

groups namely, number of male patients with an age less than 60 years, age 60 to 80 years and age more than 80 years.

Table 3.3: Grouping of male patients according to age; *n* is the number of male patients, the percentage of the total male patients is included in brackets

Age	< 60 years	60 – 80 years	> 80 years
n (%)	7 (8%)	71 (83%)	8 (9%)

3.4 Age distribution of female patients

The number of female patients included in the study were 116. Their ages ranged from 43 to 82 years old. The mean age was 64 years (SD 7.7). Table 3.4 shows grouping of female patients into three age groups namely, number of patients with an age less than 60 years, age 60 to 80 years and age more than 80 years.

Table 3.4: Grouping of female patients according to age; *n* is the number of female patients included in the study, percentage of total female patients is included in brackets

Age	< 60 years	60 – 80 years	> 80 years
n (%)	39 (33%)	74 (64%)	3 (3%)

3.5 Clinical data of cases included in the study

This section describes the findings of clinical parameters as mentioned by Kozin et al. (11) when deciding on UKA for patients requiring knee arthroplasty. These are in particular, the patient's BMI and specific parameters in evaluation of an arthritic knee during a pre-operative clinical examination.

3.5.1 Body Mass Index (BMI) for the whole study population

In the 202 patients included in the study, the body mass index ranged from 17.8 – 37.8 kg/m^2 with the mean BMI being 33.6 kg/m^2 (95% CI, 25.9 – 33.8). Table 3.5 shows the number of patients within the BMI classes as described by the World Health Organisation (WHO) on classification of body weight.

Table 3.5: The number of patients within the different BMI classes as described by WHO; *n* is the number of patients, percentages of total patients are in brackets

BMI (kg/m^2)	*n* (%)
< 18 (underweight)	4 (1.9%)
18 – 24.9 (normal healthy)	85 (42.1%)
25 – 29.9 (overweight)	70 (34.7%)
30 – 34.9 (moderate obese)	41 (20.4%)
35 – 39.9 (severe obese)	2 (0.9%)
Total	**202 (100%)**

3.5.2 BMI of male patients in the study

In the male population included in the study, the range of BMI was 17.8 to 32.4 kg/m^2. The mean BMI was 23.4 kg/m^2 (SD 3.8). Table 3.6 shows the number of male patients within the BMI classes as described by WHO.

Table 3.6: The number of male patients within the BMI classes as described by WHO: *n* represents the number of patients, percentages of total male patients are in brackets

BMI (kg/m^2)	*n* (%)
< 18 underweight	3 (3.5%)
18 – 24.9 normal	51 (59.3%)
25 – 29.9 overweight	27 (31.4%)

30 – 34.9 moderate obese	5 (5.8%)
35 – 39.9 severe obese	
> 40 very severe obese	
> 45 morbid obese	
Total	**86 (100%)**

3.5.3 BMI of female patients in the study

In the 116 female patients included in the study, the range of BMI was 17.9 to 37.8 kg/m^2. The mean BMI was 28.6 kg/m^2 (SD 4.8). Table 3.7 shows the number of patients within each BMI class as described by WHO.

Table 3.7: The number of female patients within different BMI classes as described by WHO; *n* is the number of patients, percentages of total female patients are in brackets

BMI (kg/m^2)	*n* (%)
< 18 underweight	1 (0.8%)
18 – 24.9 normal	34 (29.3%)
25 – 29.9 overweight	43 (37.1%)
30 – 34.9 obese moderate	36 (31.1%)
35 – 39.9 severe obese	2 (1.7%)
Total	**116 (100%)**

3.5.4 Clinical parameters of the knees at surgery

This section of the results shows findings on clinical evaluation of patients' knees at the time of arthroplasty surgery. The interest of our study was firstly to determine the pattern of manifestation of OA and secondly to determine whether patients were suitable for UKA or not. Therefore, the parameters looked at and presented in this section, not only represent a general impression of the overall evaluation of the knees prior arthroplasty surgery, but also what Kozin et al. (11) consider as necessary criteria when deciding on UKA for patients. These are traditionally accepted criteria when evaluating patients for UKA.

The total number of patients included in our study was 202, hence, this makes the total number of knees that were operated on. Of these 202 patients, 82 were left knees and 120 were right knees. Table 3.8 shows the findings on clinical evaluation of parameters that are considered when describing the pattern of manifestation of OA of the knee and when deciding on UKA or TKA for the affected knee.

Table 3.8: Findings of clinical parameters on evaluation of knees prior arthroplasty surgery of 202 knees, *n* represents the total number of knee with the characteristic described in the column and is the sum of *n1* and *n2* categorising the parameter further i.e. *n=n1 +n2*

Clinical Parameter	**Total (*n*)**	**Break down**	
		n1	*n2*
Deformity in coronal plane	Valgus malalignment	Valgus > 5^0	Valgus < 5^0
(*n* = 176 knees)	53	38	15
	Varus malalignment	Varus > 10^0	Varus < 10^0
(26 knees had normal alignment)	123	41	82
Knees with correctable deformity on coronal plane	133	Fully correctable	Partially correctable
		59	74
(43 knees had a non- correctable deformity)			
Deformity in sagittal plane (fixed flexion deformity)	186	FFD > 5^0	FFD < 5^0
		129	57
instability in coronal plane	6	Varus instability	Valgus instability
		0	6
Stability in sagittal plane	17	ACL deficiency	PCL deficiency
		8	9
Range of motion	< 90^0		> 90^0

	113	89

3.5.5 Radiological data of cases included in the study

The radiological data of the 202 cases was derived from X-ray evaluation of the affected knees with AP and lateral-view X-rays. For simplicity of presentation, the data are shown in a Table illustrating the number of compartments affected by OA (see Tables 3.9 and 3.10). The severity of the OA is illustrated by grouping the affected knees according to the different grades of OA by the Kellgren and Lawrence classification.

As UKA is strictly for unicompartmental knee OA or advanced SONK, the data on the number of compartments affected in the different patients are presented in Table 3.9. Here, three main categories are presented where cases with tricompartmental OA, where all three compartments of the knee are affected, bicompartmental (two compartments) and unicompartmental OA are grouped together. Further differentiation of knees with bicompartmental and unicompartmental OA groups has been made. In the bicompartmental OA, the affected compartments in the affected knee could be both the medial and lateral tibiofemoral compartments (where UKA will not be suitable) or one tibiofemoral compartment (either medial or lateral) with the patellofemoral compartment within that knee (where UKA can be suitable). In the case of knees with unicompartmental Osteoarthritis, the involvement could either be the medial or lateral tibiofemoral compartment (where UKA will be suitable) or the patellofemoral compartment (where unicondylar UKA would not be suitable and instead patellofemoral arthroplasty would be suitable).

Table 3.9: The grouping of patients on the basis of the number of knee compartments affected by OA; *n* represents the total number of knees within each category

Tricompartmental OA	**Bicompartmental OA**		**Unicompartmental OA**	
	Medial and Lateral Tibiofemoral condylar OA	One Tibiofemoral and Patelofemoral	Tibiofemoral condylar OA	Patelofemoral OA

		OA		
156	41	0	5	0

Table 3.10 below, further gives the breakdown of the knees according to the Kellgren and Lawrence classification in order to illustrate the severity grades within the different categories. Of interest in assessing for suitability of UKA, cases presenting with unicompartmental knee OA were either grade 2 or 3. None of the patients presented with Kellgren and Lawrence grade 4 diseases.

Table 3.10: Grouping of knees on the basis of the number of compartment affected by OA and illustration of severity using the Kellgren and Lawrence grading system

Tricompartmental OA		**Bicompartmental OA**		**Unicompartmental OA**	
156		41		5	
Kellgren and Lawrence grading					
Grade 0	0	Grade 0	0	Grade 0	0
Grade 1	0	Grade 1	0	Grade 1	0
Grade 2	9	Grade 2	6	Grade 2	2
Grade 3	73	Grade 3	23	Grade 3	3
Grade 4	74	Grade 4	12	Grade 4	0

Five cases were found on radiological evaluation to have unicompartmental tibiofemoral OA. These cases were potential for treatment with UKA depending on whether they could meet the criteria by Kozin et al. or not (11). Table 3.11 gives a summary of clinical and radiological data of these five cases.

Table 3.11: Summary of clinical case with unicompartmental OA

Bio-demographic data					
Patients	Case 1	Case 2	Case 3	Case 4	Case 5
Age	56	56	49	53	54
Gender	F	F	F	M	F

BMI(kg/m^2)	32	29	33	23	31
Clinical data					
Side	L	R	R	R	R
Varus	5^0 correctable	5^0 fixed		5^0 correctable	5^0 correctable
Valgus			5^0 fixed		
FFD	None	None	none	none	None
ROM	$> 90^0$	$> 90^0$	$> 90^0$	$> 90^0$	$> 90^0$
Ligaments	Intact	Intact	intact	intact	Intact
Radiologic data					
Medial joint line	Moderate OA	Moderate OA	Normal	Moderate OA	Moderate OA
Lateral joint line	Normal	Normal	Mild OA	Normal	Normal
Subchondral cysts	None	None	few	none	None
Subchondral sclerosis	Medial side	Medial side	lateral side	Medial side	Medial side
Osteophytes	Small medial	Small medial	Small lateral	Small medial	Small medial
Joint congruence	No subluxation	No subluxation	No subluxation	No subluxation	No subluxation
Kellgren and Lawrence	3	3	2	2	3

CHAPTER 4

4 Discussion

4.1 Study sample size

The power analysis for our study to have a significant conclusion was calculated to be 75 knee arthroplasty surgery cases for the three years of the study period. Following exclusion of 278 from the 480 cases within the study period, a total of 202 patients were left for data analysis. This is 2.7 times the power analysis, validating the conclusion that would be arrived at further. The explanation for such a high number of patients lies behind the fact that CHBAH is a large hospital and renders services to a community with a population of 3.5 million people.

4.2 Gender and Age distribution of the cases

The gender distribution of the 202 patients included in the study consisted of 86 men and 116 women. This made a male to female ratio of 1:1.3, making up of 30% more women than men. Although gender is not included as a criterion when deciding on UKA *versus* TKA in unicondylar OA, the sample was well represented with a good number of men and women. It is appropriate to state that the number available for analysis for both genders was adequate despite the fact that there were 30% more women than men. Literature into health-related studies reports that men and women have different health seeking behavioural patterns (25). Women are more likely to consult early for symptoms of illness than men, thus explaining the early age of presentation in many arthroplasty registries as well.

The average age at which patients present for total TKA is between 60 and 70 years (3, 5). The mean age for the overall patients included in our study was 67 years (95% CI, 66.6 – 68.6), with an age range of 43 to 86 years. Although the mean age falls within the world-wide trend, the lowest age in our study population was 43 years. This was well below the age of

presentation for arthroplasty world-wide, and was the lowest age in the female population of our study, where the age range was 43 to 82 years. In this population the mean age of 64 years (SD 7.7) conformed to the world-wide range of 60 to 70 years of presentation for knee arthroplasty.

This low age of presentation could be explained by a number of factors. The first being the difference in health seeking behaviour of both genders. Women are known to present early for the same disease than men. Moreover, is the fact that the female gender is considered a predisposition for OA and so is the high prevalence of obesity (26). Here it would be extrapolated that the age of occurrence of knee OA would be earlier in women than in men, as they carry an extra burden of gender and high BMI as added risk factors (26).

Within the male population of our study, the age range was 57 to 86 years, with a mean age of 72 years (SD 7.6). The youngest age of 57 years (60 percentile) in this gender population, together with a mean age of 72 years, do not fall far from the world-wide age range of 60 to 70 years for knee arthroplasty presentation. The male gender of our study conformed to the world-wide trend of the presentation for knee arthroplasty. This finding in a way indirectly supports the female gender as a risk factor for knee OA. It can be extrapolated to further support the notion about different health seeking behaviours of the two genders.

4.2.1 Implication of gender and age for UKA

The age of consideration for UKA in unicompartmental knee OA is above 60 years. With an overall age distribution of 43 to 86 years and a mean age of 67 years, UKA may have been suitable with regard to the age criterion. According to Table 3.2, 77% of patients were of age above 60 years. The strength of this statement was further emphasised by a mean age of 67 years and a 95% CI of 66.7 – 68.6, which is agreement with the recommended age criterion.

It is well established in literature that gender is not a considered criterion when deciding between UKA *versus* TKA for patients with unicompartmental OA. Despite this fact, the distinction of the age ranges of both genders in our study not only gives an overview of bio-demographics of arthroplasty patients seen at CHBAH, but also adds value to the implication of patients' age demographics for the practice of UKA.

In the male population 92%of men were of age above 60 years, whereas in the female population, only 67% were of age above 60 years. The implication of this comparison of the ages for the two genders is two folds. UKA would be more suitable for male patients unlike for female patients. It is important to state that the older the ages of patients at presentation for arthroplasty surgery, the more likely that the disease will be advanced (3). Although UKA would be favoured in male patients of our study, their advanced age pattern of distribution was not correlated to the severity of the disease. Resultantly, it can be concluded without doubt that the advanced age of presentation could be associated with more advanced knee disease and spread to other compartments. In which case, TKA would be favoured.

4.3 Clinical Parameters

4.3.1 BMI for the general population

Adherence to criteria by Kozin et al., for UKA in unicompartmental knee OA insists on BMI of less than 30 kg/m^2. In our study, the BMI range in all 202 patients was 17.8 to 37.8 kg/m^2, with the mean BMI of 33.6 kg/m^2 (95% CI, 25.9 – 33.8). UKA would only be suitable in 78.7% of patients whose BMI was under 30 kg/m^2. Almost one percent (0.9%) of all patients, who were severely obese, and 20.4%, who were moderately obese, could not be candidates for UKA. This is against the traditional criteria and also due to the fear of rapid wear of the implant and further progression of the disease to unaffected compartments as a result of high BMI.

4.3.2 BMI distribution for the different genders

Although gender is not a criterion for UKA, understanding BMI distribution in the two genders allowed us to critically review the characteristics of our study population. It is an established fact that obesity and other forms of excessive body weight are becoming a pandemic world-wide (27). Furthermore, this pandemic was seen more in women than in men (27).

In the male population of our study 59.3% had normal BMI, 31.4% were overweight and 5.8% were moderately obsess according to WHO classification. The latter would be unsuitable for UKA. The mean BMI was 23.4 kg/m^2 (SD 3.8), which is within normal limits of healthy weight according to WHO and well within the BMI limit for UKA. Therefore, 94.2% of male patients within our study had suitable BMI for UKA.

In the female population of our study, only 29.3% had a normal BMI. This was about half the number in the male patients with normal BMI. Almost seventy percent (69.9%) of the female patients had an abnormal BMI with 32.8% patients having BMI above 30 kg/m^2. Again, this was approximately twice as much a number of patients in the female group compared to the male patient group. This emphasises the burden of obesity within the female population. Furthermore, emphasising the significance of BMI as a risk factor for Osteoarthritis of the knee.

With regards to the BMI criterion recommended by Kozin et al., only 67.2% of women in our study population would be suitable for UKA. This is 27% lower than the number of male patients suitable for UKA in the male population of our study. This was more than two percentile and concludes that UKA would be feasible in most male patients within the study.

4.3.3 Clinical state of the knees at surgery

The proposed reason for failure of UKA is said to be poor patient selection (1). The surgeon is said to have been unable to recognise, even in unicompartmental OA, a patient with clinical parameters that would lead to early, accelerated wear of the implant and progression of the disease to unaffected knee compartments despite UKA. This subsection discusses the findings of clinical parameters that are evaluated in UKA. A detailed discussion is given with reference to popular and accepted literature on the clinical parameters when deciding for UKA and the findings in our study population.

4.3.3.1 Deformity in different planes and correctability

A commonly encountered knee deformity in OA and advanced SONK in the coronal plane (frontal view), is varus malalignment (3, 5). Here the lower limb appears to be bent outwards at the knee. Although valgus malalignment is encountered in OA of the knee, it is not as common as varus (3, 16). Furthermore, valgus malalignment is seen in most cases of inflammatory arthritis, a common encounter being Rheumatoid Arthritis (3, 5, 16). In our study 61% of knees had varus malalignment, with only 13% of patients having a normal coronal plane alignment and 26% with valgus malalignment. This is an acceptable finding that is not out of the ordinary for a study of knee OA (3, 5, 16).

UKA can be performed in knee OA with either varus or valgus malalignment. This is applicable when the deformity is not severe. In severe deformities, TKA would be preferred as it would tolerate excessive stresses from the advanced disease. The measured severity of the deformity, either varus or valgus is expressed in degrees and also whether it is correctable or not. In our study, 44% of the knees with coronal plane deformity were fully correctable. Furthermore, in the varus knee group 67% measured less than 10 degrees, with only 30% of the knees measuring less than 5 degrees in the group with valgus malalignment.

These different percentage numbers not only give an overview of the pattern of deformity within our study population, but also give an impression of evaluation of suitability for UKA. Although the decision for UKA is multifactorial, the impression created is that UKA would be more suitable in most patients with varus malalignment. In this group, the severity of the disease presents with a deformity that is mild (less than 10 degrees) and thus acceptable of UKA, compared to patients with valgus malalignment. Literature stipulates that more often a diagnosis of an autoimmune inflammatory condition can be made in arthritic knees with valgus malalignment (3, 5). As this is a contraindication to UKA, one may assume that in the 30% of knees with valgus malalignment, a delayed diagnosis of an inflammatory condition would restrict UKA within this group. Therefore, even fewer patients would be suitable for UKA.

When walking, the ideal mechanics is to have the lower limb that is in the swing phase fully straightened at the knee (3). This also applies when that limb makes initial contact with the ground, where the heel strikes the ground before the foot comes to be flat (3). These aspects lead to the next point of discussion regarding deformity in the sagittal plane (side view). In our study, only 8% of patients did not have any fixed flexion deformity. Additionally, only 30% of patients had FFD measuring less than 5 degrees. This brings down the number of knees for UKA quite significantly (62% unfit for UKA according to this criterion). With inability of the knee to extend, the different parts of the implant and the knee will be loaded abnormally. This will result in accelerated wear of the implant, eventual failure and also progression of the OA to unaffected compartments (1, 12).

The knee joint is considered to be an incongruent joint. Unlike the hip joint, where it is a congruent ball and a socket, the knee joint relies mainly on the ligaments around it for stability (2). Ligamentous instability, even when subtle, results in abnormal micro-motion and loading of the articular surfaces thereby leading to the development of OA (2, 3, 19). It is not arguable; literature does guide of instances where ligament injuries can be left untreated (5). Contrary to this, UKA is contraindicated in unstable knees (1). Implant designs only allow for loading in a stable knee (12, 19). In our study, 11.4% of knees were clinically unstable, with 8.4% knees having ligamentous deficiency in the coronal plane. Kozin et al.,

highlighted anterior cruciate ligament (ACL) insufficiency, which could be treated non-operatively in most instances, as a contraindication to UKA (1, 5). We found 3.9% of the 8.4% of knees with coronal plane instability were due to ACL insufficiency. This group contributed to the 56% of patients with post traumatic OA as the primary diagnosis. In these patients UKA could not be performed as there is an absolute contraindication.

The purpose of joint replacement is, among other things, to alleviate pain and improve function. This includes post-operative increase in range of motion (ROM), independence in activities of daily living and leisure. It has been shown in many studies that pre-operative ROM is a predictor of ROM at six months following rehabilitation (5). Furthermore, the severity of pre-operative reduction in ROM can be correlated with the severity of the affectation of a joint (3, 5). The recommended pre-operative ROM where one should consider UKA in unicompartmental OA is a minimum of 90 degrees. This is optimal range for good function. In these instances, the surgery is simple and not extensive (5). Our study had 44% of patients with ROM of 90 degrees or more. For these patients, UKA could be considered. For the remaining 56% of study population, surgery would need to be extensive in order to perform the necessary releases to improve ROM. In these cases, TKA was the appropriate surgery.

4.4 Radiological Data

For the purpose of our study X-rays were used for the evaluation of pathology. X-rays were used as a tool in the completion of the diagnostic work up and grading of the severity of the disease. More importantly for our study, they helped in pre-operative evaluation of the number of compartment affected by OA, including staging of the severity of the disease process. It is important that we highlight that X-rays cannot be used alone for deciding on treatment, despite their appealing nature. This is applicable in all fields of medicine. A full clinical evaluation of patients is still mandatory and X-rays are only for adjunct use.

4.4.1. Cases with more than one compartment affected by OA

We found 77% of our study population to have all three compartments affected by OA on radiological evaluation. In these cases, UKA could not be performed. This was a common finding in patients where the definite diagnosis was secondary OA of the knee. Another 20% were found to have bicompartmental OA, involving both the tibiofemoral compartments. Again, this was not an uncommon finding. Common diagnoses in these two groups were post traumatic OA, following fractures and knee ligamentous injuries and SONK. The findings in these two groups of patients, i.e. tricompartmental and bicompartmental OA, make up every day arthroplasty patients (5, 22, 23). The treatment option is seldom arguable in these instances and is constantly TKA, just as it was in our 97% of patients with multi-compartmental disease.

The burden of disease in arthroplasty units across the country is demonstrated by the severity of OA at surgery. The waiting period for a joint replacement is estimated to be at least two years (24). Surgery is not performed immediately on demand as the number of patients on waiting lists is overwhelming to the South African health care system. Therefore, the disease becomes advanced and severe as the patients continue to load the affected joint while waiting for surgery. This was highlighted in our study as the majority of patients presented with stages 3 and 4 of knee disease, when using the Kellgren and Lawrence Knee OA severity grading system. In patients with tricompartmental knee involvement, 47% had stage 4 knee OA and 46% had disease severity stage 3. Furthermore, in patients with bicompartmental OA, 29% had stage 4 diseases while 56% were on stage 3. These are merely reflective of the burden of disease in our country and also of the pattern of OA seen at the CHBAH arthroplasty unit.

4.4.2 Cases with unicompartmental involvement

Cases with unicompartmental knee OA made up only 2.5% of the whole patient sample size. This was less than the percentage number cited by Kozin et al., where they found 6% of their population (11). Among these, two patients were Kellgren and Lawrence stage 2 and three

patients were Kellgren and Lawrence stage 3. The primary requirement for UKA is for the disease to be unicompartmental among other criteria. The severity of the disease, as graded using the Kellgren and Lawrence classification for staging knee OA, is not mentioned anywhere to have bearing on the decision to perform either UKA or TKA. Failure of UKA was initially found to arise from the spread of the disease to unaffected compartments and also due to accelerated implant wear. It is needless to mention that in cases of advanced unicompartmental OA, spread to other compartments is likely. This is the normal pathophysiologic progression of OA (22, 23). Therefore, in knees with advanced unicompartmental OA (Kellgren and Lawrence classification stages 3 and 4), it may be a common intra-operative finding to discover mild involvement of the previously unsuspected compartment, in which case a TKA would be mandatory.

Table 3.11 gave a summary of the clinical and radiological information of the five cases found to have unicompartmental knee OA. When matching the clinical features against the traditional criteria for suitability of UKA, all patients were below age 60 years with the closest age being 56 years old. The youngest patient was 49 years old and the disease grade was Kellgren and Lawrence stage 2. The other four older patients had Kellgren and Lawrence stage 3. This characteristic may be taken to be an illustration of the progression of disease as the severity worsens with age. The BMI of three of the five patients was above 30 kg/m^2 and 29 kg/m^2 in one patient, which is borderline to what is accepted for UKA. Only that of the male patient was 23 kg/m^2. Obesity has been explained to be a pandemic, even in developing countries such as South Africa, affecting women more than men (27). The finding of high BMI among the four female patients is therefore not a surprising restriction to UKA.

Clinical examination of the knees of all our five patients revealed unicompartmental affectation by OA. They showed no contraindication to UKA on clinical and radiological evaluation. All of them had correctable deformities that measured within the recommended range for UKA, i.e. varus and valgus less than 10 and 5 degrees, respectively. The arcs of motion were at least 90 degrees and they showed neither fixed flexion deformities nor ligamentous instability. These would be suitable for UKA, only due to the patients' young ages and high BMIs; these patients would not be suitable candidates for UKA. This is not an

uncommon finding in clinical medicine, where treatment that is suitably appealing is prohibited by an arguable factor, such as age and BMI to some an extent.

4.5 General discussion

The primary objectives of our study were to determine whether UKA could have been performed in any of the 202 patients following giving careful attention to the generally accepted traditional criteria. Additionally, we wanted to determine the incidence of knee arthroplasty and the pattern of OA in patients seen at CHBAH. Both these were looked at and biostatistical analysis was done on the data thereby giving us a calculable conclusion. According to Kozin et al. at least 6% of the general arthroplasty population should be suitable for UKA. This is only applicable when there is strict adherence to his criteria for deciding on UKA. In our study no patients were found to be suitable for UKA. Only 2.5% of the study population were found to have unicompartmental knee OA. Although, the clinical parameters on pre-operative evaluation suited selection for UKA, this could not be performed due to young age and high BMI in these patients.

The criteria by Kozin et al. having been validated and accepted by various authors in many other studies (1, 3, 11, 12). Furthermore, use of their criteria has demonstrated over 95% survivorship of implants of up to 15 years (1). Parameters such as BMI, patient's age and level of physical activity are now under severe scrutiny in many new publications. This is partly because of the use of new and improved implants used for UKA. These are being used in patients who are as young as 45 years, BMI of up to 35 kg/m^2 and higher levels of physical activity. We only await survivorship studies using these implants, which are thus far promising.

The main finding with regards to the pattern of OA of the knee is that at the time of surgery, knees on which TKA is performed at CHBAH, have advanced and severe stages of the

disease. Over the three-year study period 433 primary knee surgeries were performed. This is a large number of surgeries, but it does not meet the demands subjected to the health care systems by the large volumes of patients awaiting arthroplasty surgery.

4.6 Recommendations

- **Study into the new criteria for UKA:**

  Our study looked at suitability of UKA in unicompartmental OA of the knee using the popular criteria by Kozin et al. The criteria were popularised as they emphasised parameters that would prevent early implant wear and progression of disease to uninvolved compartments. Currently with new biomaterials, improvement in surgical techniques and implant designs the survivorship of UKA is expected to have improved beyond that demonstrated when following criteria by Kozin et al.. It would be worthwhile to repeat the study looking at the suitability for UKA with new criteria. The parameters would include higher BMI of up to 35 kg/m^2, younger age (as young as 45 years) and higher level of physical activity. We anticipate more patients would be found to be suitable for UKA.

- **Conduct suitability study on patients at initial presentation to the arthroplasty unit:**

  Our study was conducted on patients who at surgery were already intended for TKA. These are patients who had been following up at CHBAH for a long time while an attempt was being made to exhaust non-operative treatment of their knee OA. As the disease is not static, one could hypothesise that there would be more patients with unicompartmental OA of the knee if the study could be conducted on new patients arriving as new referrals to the CHBAH arthroplasty unit. This recommendation stems from the fact that the indications for UKA and TKA run parallel. TKA is performed more as an ultimate resort in patients with end-stage OA where non-arthroplasty measures have become insufficient (5). On the other hand, UKA is performed earlier

on in disease to prevent progression to unaffected compartments when the disease is already irreversible with non-arthroplasty measures (3, 5).

- **Finding a more effective way of measuring physical activity level:**

  In our review of the literature, we could not find a reliable method of evaluating individual patients' levels of physical activity. Implant wear can be minimised if limited demand is placed on it by patients, and this can be done by lowering patient's BMI and physical activity. By offering UKA to elderly patients (age more than 60 years), it is assumed that these patients live a more sedentary life style and have low levels of physical activity. As we live in a world where physical wellbeing is encouraged, even individuals over the age of 60 years embark on high level of physical activity, all in an attempt to stay healthy. It is therefore becoming erroneous to assume that elderly individuals are less physically active. The idea that performing UKA to individuals over the age of 60 years may be flawed and a more reliable method of assessing an individual's levels of physical activity is necessary, especially for studies such as ours where implant wear relies on the load transmitted with physical activity.

- **A look into the gender differences in available registries:**

  One finding in our study was a varied nature of presentation of knee OA in men compared to women. Men appeared to present at an older age for knee arthroplasty than women. Furthermore, the severity of disease was moderate in men. Together with the fact that women had a higher BMI than men, all these seem to imply that the disease course tends to be moderate in men than women. This may be because of an earlier onset in women, also compounded by an aggravating factor being a high BMI, which is more common in this gender. The bio-demographics of OA of the knee are well documented in the literature. One poorly described phenomenon is the difference in the nature and characteristics of knee OA between men and women. These would

contribute in comparing the observed pattern of manifestation of knee OA at CHBAH to a larger population.

CHAPTER 5

5 Conclusion

Until the late 1990s, UKA was a common surgical procedure, performed to patients with unicompartmental knee OA. The practice became less popular following higher rates of failure. The re-emergence of UKA comes motivated with new and constantly evolving patient selection criteria. One popular traditional set of criteria are those by Kozin et al., and adherence to these criteria showed long implant survival.

With review of the literature we were able to conclude that UKA was cheaper than TKA, both for the implants and the surgery. Furthermore, hospital stay is shorter following UKA when compared to TKA, and rehabilitation is quicker in the former. These benefits are cost savings, shorter rehabilitation and reduced complication rates, which for a developing country such as South Africa is appealing. Arthroplasty has an expected life span and patients may need revision. We have also critically reviewed the literature and concluded that revision from UKA to TKA is not only easier to perform, but also has better functional outcome and associated morbidity.

In addition to determining the suitability of UKA at CHBAH, other objectives of our study included determination of the pattern of manifestation of knee Osteoarthritis at CHBAH, together with the prevalence of arthroplasty. Overall, we have found that patients treated for knee OA, presented with advanced and severe stages of the disease. This is not surprising given the long waiting time and the overwhelming number of patients seen at public hospitals across the country.

In patients treated with TKA at the CHBAH arthroplasty unit between 2015 and 2017, none were found to be suitable for UKA. This includes patients found to have unicompartmental OA of the knee. The statistical attribute to this finding was not only due to majority of patients presenting with advanced and severe stages of the disease, but also due to high BMI. For patients presenting with unicompartmental knee OA, a young age was also a contraindication to UKA.

The world of arthroplasty is constantly and rapidly evolving. Massive amount of research has gone into unicompartmental knee arthroplasty. This is on new and improved biomaterial and implants. At this point, the big question that is being asked remains on selection criteria for UKA. We only await long term results.

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Appendices

Appendix A: Data Collection Sheet

Unicompartmental Knee Arthroplasty Suitability study: CHBAH

Patient study no:

Age:

Gender:

BMI:

Underlying diagnosis:

Treatment offered:

Clinical parameters:

OUTCOME	
Included in study	Excluded in study
Feasible for UKA	Not feasible for UKA
If not feasible reason	

	Left knee	R Knee
Side of disease		
Deformity in coronal plane measured		
Correct-ability of the deformity		
Deformity in sagittal plane measured		
Correct -ability of the deformity		
Stability		
Range of Motion		

Knee X-ray findings:

AP View	L Knee			R knee		
	AP Medial compartment	AP lateral compartment	Lateral X-ray	AP Medial compartment	AP Lateral compartment	Lateral X-ray
Reduced joint line						

(5mm)						
Osteophytes						
Cysts						
Subluxability						

Appendix B: University of the Witwatersrand Human Research Ethics Approval

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Dr Edmund Nkhensani Thwala

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M180513

NAME: (Principal Investigator)	Dr Edmund Nkhensani Thwala
DEPARTMENT:	Orthopaedic Surgery Chris Hani Baragwanath Academic Hospital Department of Orthopaedics
PROJECT TITLE:	Unicompartmental Knee Arthroplasty Feasibility at Chris Hani Baragwanath Academic Hospital (CHBAH)
DATE CONSIDERED:	25/05/2018
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Prof C Frey
APPROVED BY:	CB Penny Professor CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	06/08/2018

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in **May** and will therefore be due in the month of **May** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature

Date 2019/11/02

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix C: Chris Hani Baragwanath Academic Hospital Orthopaedics Departmental Approval

CHRIS HANI BARAGWANATH HOSPITAL

DIVISION OF ORTHOPAEDIC SURGERY
P.O. BERTSHAM

Department of Orthopaedic Surgery
Chris Hani Baragwanath Hospital
Soweto, Johannesburg

Tel.No (011) 933 8914
Fax No (011) 822 3831

Tuesday, 17 April 18

To Dr Thwala E N
Orthopedic Registrar
Department of Orthopaedic Surgery
Chris Hani Baragwanath Hospital
Soweto, Johannesburg

Re: Departmental approval to conduct research for MMED degree with the heading

Uni-compartmental knee Arthroplasty feasibility at Chris Hani Baragwanath Academic Hospital

Dear Sir,

This letter is to confirm that the Department of Orthopaedics, CHBAH approves you desire to do your research for MMED degree in the Arthroplasty department of Orthopaedic CHBAH under the above heading.

Sincerely,

.....

Prof MT Ramokgopa/ Prof Magobotha
HOD Dept. Orthopaedics
CHBAH

Appendix D: Chris Hani Baragwanath Academic Hospital Institutional Study Conduction Approval

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

MEDICAL ADVISORY COMMITTEE

CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL

PERMISSION TO CONDUCT RESEARCH

Date: 24th April 2018

TITLE OF PROJECT:

Uni-Compartmental Knee Arthroplasty Feasilility at Chris Hani Baragwanath Academic Hospital

UNIVERSITY: Witwatersrand

Principal Investigator: Dr E.N. Thwala

Department: Orthopaedic Sugery

Supervisor : Prof C Frey

Permission Head Department (where research conducted): Yes

The Medical Advisory Committee recommends that the said research be conducted at Chris Hani Baragwanath Academic Hospital. The CEO / management of Chris Hani Baragwanath Academic Hospital is accordingly informed and the study is subject to:-

- Permission having been granted by the Committee for Research on Human Subjects of the University of the Witwatersrand.
- The Hospital will not incur extra costs as a result of the research being conducted on its patients within the hospital
- The MAC will be informed of any serious adverse events as soon as they occur
- Permission is granted for the duration of the Ethics Committee Approval.

.....
Recommended
(On behalf of the MAC)
Date: 24/4/2018

.....
Approved/Not Approved
Hospital Management
Date: 26/04/18